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Maintenance function and management

Instandhaltungsfunktion und -management

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Maintenance function and management

Instandhaltungsfunktion und -management

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 319.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 17948:2023) has been prepared by Technical Committee CEN/TC 319 “Maintenance”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

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Introduction

This document is part of a set of maintenance standards produced by CEN/TC 319 where it holds a central place because it introduces maintenance, its organization and management and establishes close links with the other standards of CEN/TC 319. Annex A presents the framework and an overview of the available CEN/TC 319 maintenance standards divided into four groups: Common basis, Management, Methodologies, and Resources. This document belongs to the Management group.

Maintenance is a set of activities that requires effective management able to anticipate, react quickly to events, and adapt to business changes. It has an essential role in controlling plant safety and occupational and environmental risks as well as ensuring the competitiveness and the durability of organisations and companies.

Therefore, the importance of effective maintenance management is major, and this document gives guidelines for maintenance managers to develop a process contributing to the success factors defined by the managing board. It is based on the existing European standards and, in particular, those which describe the role of maintenance within asset management, the maintenance processes and their inter-relationships, the maintenance of buildings and infrastructures, maintenance key performance indicators, maintenance support processes such as documentation, contracts, qualification of maintenance personnel, etc.

This document is intended to help maintenance managers develop the maintenance management process in its various aspects (maintenance policy, maintenance objectives, maintenance strategy, internal/outsourced activities, organization of functions, job profiles and responsibilities, budgets, supervision of maintenance activities, communication, and continuous improvement).

Annex B describes examples of levels of maintenance.

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1 Scope

This document describes the main content of maintenance management and the main activities for which maintenance management is responsible.

The document is intended to guide maintenance managers and asset managers in charge of maintenance of items in industrial sectors (both manufacturing and services) and infrastructures/buildings in order to achieve the success factors of the organizations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 17007:2017, *Maintenance process and associated indicators*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

item

part, component, device, subsystem, functional unit, equipment or system that can be individually described and considered

Note 1 to entry: A number of items e.g., a population of items, or a sample, may itself be considered as an item.

Note 2 to entry: An item may consist of hardware, software or both.

Note 3 to entry: Software consists of programs, procedures, rules, documentation, and data of an information processing system.

[SOURCE: EN 13306:2017, definition 3.1]

3.2

physical asset

item that has potential or actual value to an organization

Note 1 to entry: Examples of physical assets are components, machines, plants, buildings, infrastructures, etc.

[SOURCE: EN 13306:2017, definition 3.2]

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maintenance**

combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function

Note 1 to entry: Technical maintenance actions include observation and analyses of the item state (e.g., inspection, monitoring, testing, diagnosis, prognosis, etc.) and active maintenance actions (e.g., repair, refurbishment).

Note 2 to entry: See also the definitions of improvement and modification.

[SOURCE: EN 13306:2017, definition 2.1]

**3.4
maintenance management**

all activities of the management that determine the maintenance requirements, objectives, strategies and responsibilities, and implementation of them by such means as maintenance planning, maintenance control, and the improvement of maintenance activities and economics

[SOURCE: EN 13306:2017, definition 2.2]

**3.5
process**

set of interrelated or interacting activities that use inputs to deliver an intended result

[SOURCE: EN ISO 9000:2015, definition 3.4.1]

**3.6
maintenance function**

role and responsibility entrusted to entities within an organization for achieving maintenance objectives

**3.7
maintenance policy**

definition of the maintenance objectives, line of maintenance, indenture levels, maintenance levels, maintenance support, and their interrelationships

Note 1 to entry: The maintenance policy provides the basis for maintenance planning, determining supportability requirements, and developing logistic support.

[SOURCE: IEC 60050-192:2015]

**3.8
maintenance strategy**

management method used in order to achieve the maintenance objectives

EXAMPLE Outsourcing of maintenance, allocation of resources, etc.

[SOURCE: EN 13306:2017, definition 2.4]

3.9

life cycle

series of stages through which an item goes, from its conception to disposal

EXAMPLE A typical system lifecycle consists of acquisition, operation, maintenance, modernization, decommissioning and/or disposal.

Note 1 to entry: The stages identified will vary with the application.

[SOURCE: EN 13306:2017, definition 4.18]

3.10

sustainable development

development that meets the needs of the present without compromising the ability of future generations to meet their own needs

[SOURCE: UN Brundtland Commission report, 1987]

3.11

indenture level

level of sub-division within an item hierarchy

EXAMPLE System, subsystem and component.

Note 1 to entry: From the maintenance perspective, the indenture level depends on the complexity of the item's construction, the accessibility to sub-items, skill level of maintenance personnel, test equipment facilities, safety considerations, etc.

[SOURCE: EN 13306:2017, definition 3.7]

3.12

line of maintenance

maintenance echelon

position in an organization where specified levels of maintenance are to be carried out on an item

EXAMPLE Field (first line maintenance), workshop (second line maintenance) and manufacturer (third line maintenance).

Note 1 to entry: The lines of maintenance are characterized by the skill required of the personnel, the facilities available, the location, the complexity of the maintenance task, etc.

[SOURCE: EN 13306:2017, definition 10.3]

prEN 17948:2023 (E)**3.13****maintenance level**

maintenance task categorization by complexity

EXAMPLES

- Level 1 is characterized by simple actions carried out with minimal training.
- Level 2 is characterized by basic actions which have to be carried out by qualified personnel using detailed procedures.
- Level 3 is characterized by complex actions carried out by qualified technical personnel using detailed procedures.
- Level 4 is characterized by actions which imply the know-how of a technique or a technology and carried out by specialized technical personnel.
- Level 5 is characterized by actions which imply a knowledge held by the manufacturer or a specialized company with industrial logistic support equipment.

Note 1 to entry: The maintenance level may be related to the indenture level.

[SOURCE: EN 13306:2017, definition 7.18]

3.14**competence**

proven ability to use knowledge, skills, and personal, social and/or methodological abilities, in work or study situations and in professional and personal development

Note 1 to entry: Competence is described in terms of responsibility and autonomy.

[SOURCE: EN 15628:2014, definition 3.1]

3.15**indicator**

quantitative or qualitative measure of a characteristic or a set of characteristics of a phenomenon or performance of activities, according to defined criteria or a given formula or questionnaire

Note 1 to entry: The indicator is a tool for development and implementation of a strategy for monitoring progress towards the goals outlined in the strategy.

[SOURCE: EN 15341:2019+A1:2022, definition 3.3]

3.16**scorecard**

set of associated, consistent, and complementary indicators providing synthetic and global information

Note 1 to entry: It is a tool for the development and implementation of a strategy and for monitoring progress towards the goals outlined in the strategy.

4 Maintenance framework

4.1 Maintenance contributions and challenges

Maintenance intends preventing failures and shutdowns which can have serious consequences and it therefore constitutes a risks control measure. It is a shield to defend against undesirable events and, as such, maintenance implements defensive tasks and contributes to risk management and dependability as indicated in IEC 60300-3-1.

Maintenance is also a crucial way to optimize the performance of an organization and, as such, it strongly contributes to Asset Management, introduced in the ISO 55000 standard, aiming to translate into decisions and actions the strategic objectives of companies and organisations. This is achieved by acting on the processes of design, acquisition and sale, renovation, production, and maintenance. Maintenance is indeed an essential area to ensure efficient and profitable management of assets. Coordinated with the other processes, maintenance optimizes the value created and plays a key role in asset management (see EN 16646:2014, EN 17485:2021).

Maintenance is as well a basic pillar of sustainable development. There are four intertwined dimensions to sustainable development: society, environment, culture and economy. In 2015, the United Nations adopted its Agenda 2030 with 17 sustainable development goals. Designing a physical asset by planning and facilitating its maintenance and then constantly maintaining it in good condition during its life cycle is to ensure a longer life. This therefore helps to reduce raw materials and energy to rebuild it, which is a benefit for the environment and for economic efficiency. It is also giving work locally because maintenance is a set of local activities, which is social benefit. The three characteristics of sustainable development are thus met by maintenance.

Maintenance brings together a large number of technical, administrative and managerial professions and which is directly concerned by the rise of digitization. In the context of “enabling technologies” there will be considerable developments, both in the techniques of fault diagnosis and prognosis and in the implementation of new maintenance strategies.

4.2 Maintenance types

Maintenance consists of managerial, administrative and technical activities to be performed on the physical assets to enable them carrying out the required function and upstream and downstream maintenance activities as described in EN 17007:2017 and Annex A.

The various types of maintenance have different characteristics that make them very complementary. A maintenance strategy is built by choosing the types of tasks to be privileged according to the physical assets, the operational context, and the strategic objectives of the company.

At the first level we can distinguish:

- a) Corrective maintenance which is carried out after a fault detection and consists in restoring the item in a condition to perform its required function. It will be the more effective when maintainability of the item is high, and the logistic support is adequate. This maintenance is often suffered, but it can also be chosen when the strategy has established that it is better to wait for failure than to perform tasks to avoid it. In particular, this can be the case when the failure has no direct effect on functions immediately required and corrective maintenance can be postponed and scheduled for a chosen date.
- b) Preventive maintenance is used to prevent failures and therefore shall be performed before acceptable performance of the required function is lost. It increases the operational reliability and the availability of items. There are several types of preventive maintenance which are described below.

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- c) Improvement of technical characteristics of items which consists of changing their intrinsic reliability, maintainability, or safety by modifying their design or manufacture. When possible, the result can be more efficient and sustainable than using preventive maintenance, which does not change the intrinsic reliability of assets but only their operational reliability.

Preventive maintenance in turn distinguishes several types:

- d) Predetermined maintenance which consists of performing preventive action on an item at given instants according to a determined number of units of use. This maintenance consists of replacing components, adjusting, lubricating, cleaning, preventively repairing all, or parts of, an item. Therefore, it is active preventive maintenance carried out without observing at first the state of the item. It is fully justified when a failure mechanism is known (wear, aging, for example) and the date of the failure can be established based on units of use.
- e) Condition based maintenance which contains tasks to observe the state of an item and active preventive maintenance tasks which are performed, or not, depending on the actual item state. Observations can consist of physical measurements with sensors (vibrations, temperatures, intensities, images, etc.) or sense-based observations (visual, noise, etc.). Two types of condition-based maintenance can be discerned:
- 1) non-predictive condition-based maintenance when the active preventive maintenance action to restore the item is triggered by exceeding a given threshold, but there is no possibility to predict the date of the failure;
 - 2) predictive maintenance when advanced methods and techniques of observation and analysis make it possible to optimally forecast the date to perform the active preventive maintenance task.

Predictive maintenance is now the subject of much promising research thanks to the very fast progress of digital technology. It is based in particular on the development of multiple techniques that make it possible to diagnose the state of items and forecast their evolution:

- f) Internet of Thing (IOT). The abundance of low-cost sensors integrated into equipment that captures, stores, treats and transmits data, provides access to a multitude of physical quantities and information on the item's states.
- g) Big Data and cloud computing allow the storage of large and diverse information, accessible in a secure and rapid manner, and associated with processing capacities that allow in-depth analysis.
- h) Machine Learning and deep learning using artificial intelligence (AI). The use of advanced and specialized algorithms allows the analysis of large amounts of data to automatically discover correlations and use them to make diagnoses and forecasts on the state of the observed items.
- i) Digital Twin is the digital model of an item which makes it possible to understand and forecast the behaviour of its physical twin in the real world and to deduce the maintenance actions to be undertaken.

4.3 Maintenance process

Maintenance is not limited to performing maintenance tasks on items. A large number of activities are necessary to define, prepare, schedule, coordinate, and evaluate the maintenance tasks and provide them with all the necessary resources.

Therefore, maintenance consists of a set of organized and coordinated activities, using resources and carried out by various actors to achieve a given result. According to ISO 9001, definition maintenance is